SEMI-ANNUAL STATUS REPORT

June 1 - November 30, 1965

A PATROL OF THE LUNAR SURFACE WITH A 24-INCH REFLECTOR AND IMAGE ORTHICON SYSTEM

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NARRATIVE ACCOUNT OF ACTIVITIES DURING PERIOD

The period can be characterized as one of straightforward transition from the state of no telescope and no image orthicon electronic equipment on the Corralitos site on June 1 to a fully operative, debugged system at the close of the period. The full program of continuous observation of the moon visually through color filters and by auxiliary photography went into effect October 27. Although color filters had been used earlier than this date, the rotating filter wheel with both color and neutral-density filters gave us for the first time the opportunity of observing the moon in two colors sequentially in one-second alternations. For all practical purposes, thus, the program did not get off the ground until November 1965; but it is now fully operational and no changes to the basic program of observation is contemplated although significant refinements are being considered (see recommendations). We state with confidence that during the period November 1 - 30, 1965, no changes within the detection capabilities of the Corralitos instrumentation occurred while the moon was above the horizon in Las Cruces during clear nighttime hours.

The moon has been, and continues to be, observed <u>continuously</u> from the time it is 7^{o} above the horizon to when it is within a few degrees of the western horizon, whenever this occurs during the hours of darkness and weather permitting. Although no color changes have as yet been noted by any of the four experienced observers, control observations of the bands of Jupiter have shown that the system is capable of detecting relatively minor color changes, as demonstrated by the blinking effect of Jupiter's bands when viewed alternately through the two filters of the rotating wheel.

The location of the observatory has proved most excellent, the wind being generally less than at the originally comtemplated site, at Organ Mountain, where Northwestern University has a smaller image orthicon installation. The virtual absence of all lights along the horizon gives a photometric sky not surpassed by any other location in the United States known to the writers. Coupled with the excellent transparency is the general good quality of the seeing which allows one to approach the theoretical resolution of the telescope.

The problem of communications is paramount. Should a change on the lunar surface be noted, we are still not in a position to notify with any certainty other observers in the country. Even notifying Flagstaff is problematical, since there are no direct telephone connections to the observers in Flagstaff. At the close of the period we investigated the feasibility of tying in with the amateur radio network, Astro-Net whose center is in Los Angeles. We have since been officially registered with the Astro-Net, but there is no local radio amateur outlet in Las Cruces. We now contemplate nightly monitoring of the Astro-Net by suitable receiver and are exploring the possibility of active participation in the net by installing a radio transmitter at Corralitos.

PRESENT OBSERVATIONAL TECHNIQUES

During the period many approaches to the patrol of the lunar surface were tried. Toward the end of the period, however, the following observational technique was adopted as standard and will be so continued in the interest of consistency until such time as a major technological improvement warrants.

The basic instrument is a twenty-four inch Cassegrain reflector to which is attached an image orthicon camera having a rotating color-filter wheel mounted immediately in front of the orthicon cathode. The telescope was manufactured by Ferson Optical Co. and is housed in a 16' by 20' cement block building supporting a 16' Ash dome. The electronic train was designed and built at the Dearborn Observatory in Evanston and installed by Mr. William Powers in late June and July, 1965. It incorporates many unique features not found in commercially available TV chains (see appendix for full technical description). The rotating color filter wheel was fabricated and installed by Mr. Justus Dunlap, Chief Observer at Corralitos Observatory.

The observational program is being handled by a team of four observers under the supervision of the chief observer. If the observers are designated as A, B, C, and D, assigments on successive nights are scheduled in the following sequence: AC, AD, BC, & BD, A and B being the senior observers.

The pair of observers spell each other in alternate periods of fifteen or twenty minutes, depending largely on the time it takes that particular observer to complete one full cycle of lunar observation. The field of view of the visual monitor is 6 by 6 minutes of arc. The monitor is itself 9 by 9 inches. A 600-line scan range is used; thus one line pair corresponds to slightly more than $\frac{1}{2}$ second of arc. The observer is seated 2 to 3 feet in front of the monitor and systemmatically trains on successive portions of the screen, allowing several alternations of red and blue filters for each feature. The entire surface of the visible moon is surveyed, but it is a practice to center each successive 6 by 6 minute area on features most likely to show changes, e.g. Aristarchus. The observer starts the examination of each new area from the central feature, working out in a "square spiral" to the perimeter of the field and using a reasonable amount of overlap. As

has been mentioned in previous reports, means for instantaneous photography are at hand should lunar surface changes be suspected. Control photographs are taken periodically for record purposes and to keep the observers in practice for a lunar event. Some 400 pictures have been taken during the report period.

Observers have reported relatively low incidence of eye fatigue since every attampt is made to compensate, by means of neutral density filters, for the difference in sensitivity of the image orthicon cathode to the red and blue portions of the spectrum. It is gratifying to know that the fatigue is not as great as was originally expected, it being not much more than encountered in ordinary TV viewing. Undoubtedly the fact that the observer is located several feet away from the monitor screen and does not have to look through an eye-piece contributes greatly to this. The fact that the observers can be casually dressed and comfortably seated in a warm room likewise is a contributing factor.

PERSONNEL

The Corralitor Observatory is in charge of Mr. Justus Dunlap who is fully responsible for its operation and for the execution of all aspects of the program. During the period he has had under his supervision the following observers: Two undergraduate astronomy students, Mr. William Schierer (Northwestern) and Mr. Robert Shanklin (Ohio Wesleyan), were on the job during the summer months. Although employed as observers, most of their time was spent in assisting in the installation of equipment, in "debugging", and later in observations utilizing a manual filter control. In July Mr. Randall Cooper and Mr. William Ohlhausen were assigned to the Corralitos

observatory roster from the Organ Mountain Station. At the end of August two permanent observers were employed to replace the summer assistants: Mr. Herbert Hartman and Mr. James Gallivan, both graduate students at New Mexico State University.

It was most fortunate that the two Organ Mountain observers could be phased into the program. During the light of the moon when the 12-inch Organ Mountain telescope, then regularly used for star cluster work, as well as for probe detection, was hampered by moonlight, these observers used that time to familiarize themselves with lunar features and with the NASA lunar survey program needs. It should be pointed out here, however, that one of the four observers is not being paid from the project budget. Only because of the observing assignment schedule being followed at Corralitos and because of the relatively light load at Organ Mountain, have we been able to pool the observers from both installations. As the research activity at Organ Mountain increases it will most likely be necessary to add a fourth observer's slot to the lunar patrol project budget.

The present observers appear to be very well suited to the program and no rapid turnover seems likely. This had been a definite fear during the planning stages of this program, since it is obvious that the program demands many long hours of activity during which nothing happens. This calls for a specific type of temperament in the observer; he must remain alert and maintain interest despite long periods of routine observation.

WEATHER & OBSERVING CONDITIONS

The weather followed the generally expected pattern during this period. The rainy season in New Mexico is, in general, July and August. However,

during the entire report period the custom was followed of having observers on duty regardless of the weather so that any breaks could be immediately utilized. This is especially important since the Observatory is some 21 miles from town and if observers were to be in attendance only when the weather was assuredly clear, much usable sky would be lost. Furthermore, by having the observers in constant attendance, even mediocre skies are utilized since even light uniform haze cover permits this type of observation whereas it would close down photometric observations.

The best weather generally occurs in the fall, and the past year was no exception. During September and October the weather was generally excellent and observation was on a continuous basis even though the present rotating filter wheel had not yet been installed.

DEDICATION & VISITORS

The Corralitos Observatory was formally dedicated on October 12, 1965. Speakers in addition to the principal investigator and the chief observer included Simeon E. Leland (Dean of the College of Arts and Sciences at Northwestern), Dr. William E. Brunk (Head of Planetary Astronomy, Lunar and Planetary Programs, NASA), and a representative of the Hon. Jack Campbell (Governor of New Mexico). Guests included the NMSU Observatory staff, Smithsonian Satellite Tracking Station staff, and local dignitaries. In addition, throughout the report period Corralitos Observatory was visited by many interested persons from NASA and other government agencies, and from other scientific institutions and industrial firms engaged in image orthicon research.

PLANS AND RECOMMENDATIONS

The basic plan of observation will be continued during the next re-

port period. A new filter wheel is planned, incorporating many separate filters which can be used in conjunction with the present rotating color wheel. The auxiliary wheel will have ten positions:

1. opaque
2. clear
3,4. cross/polarization filters
5,6,7,8. neutral density filters to compensate for increased light level with advancing phase of the moon
9,10. special purpose filters

The present color filter wheel has a 2-second cycle during which the blue and red filters are in position for 0.5 second, respectively. The bright period of nearly 1 second separates each filter cycle. Since an image orthicon target requires a finite time to allow the target to be erased, very rapid alternations of the blue and red filters are impossible. Although the present filter rates seem entirely adequate, it is possible that a more rapid variation might have some advantages. Accordingly, we have been exploring other approaches. One is to feed the red and blue filter output into two identical nondestructive storage tubes which, by playing into two identical monitors, would then allow through a split beam technique the familiar blink microscope method to be applied. This would have the additional advantage that any secondary differences in the general light level between the red and blue filters could be compensated for in the viewing monitors. Such exact matching would prove valuable in compensating for the variable atmospheric transmissions, particularly as the moon nears the horizon. At such times the red image grows differentially stronger with respect to the blue image and could lead to false reports of color changes, especially if a new and inexperienced observer were on duty. The

use of the two storage tubes would allow the red and blue images to be frequently adjusted for exact balance.

Another manner in which this same objective could be accomplished would be to have two identical image orthicon trains, each being fed respectively by light from a beam splitter from the primary optical train.

Because many changes on the moon might be more easily detectable in the infrared than the visual, it is recommended that explorations be allowed into the use of an SEC vidicon system with an infrared emissive surface. Such a system would be much less costly to operate than were one to use an infrared image orthicon system. Further, because of its essential simplicity it could be mounted on the same telescope drive system.